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Oak Decline On Public Lands In The Central Forest Region

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ABSTRACT.—Discusses characteristics of oak species and stands of the central forest region relevant to oak decline and its management.

KEY WORDS: Mortality, cohort senescence, *Quercus*.

The oak-hickory forests of eastern North America have been periodically subjected to stresses that caused growth declines and tree mortality (Kessler 1989, Millers *et al.* 1989). The forests soon recovered after the stress agents disappeared or lessened. Recently, concerns have been raised that North American oak-hickory forests may be entering an extended period unfavorable for their growth (Shriner *et al.* 1986, Starkey and Brown 1986). The new scenario envisions pressure from gypsy moth invasion of the complete eastern oak range, and increased injury from extended droughts that may occur if air temperatures increase as a predicted consequence of expected global warming trends (Laurmann 1986, N.A.S. 1983).

Many causes of oak decline have been described (Millers *et al.* 1989). Of these, drought and insect defoliation are the most common triggers. Low temperature injury, site, and stand conditions are other factors that seem to be involved often in oak decline episodes. In North America,

air pollutants have not been shown to contribute to oak decline except for damage limited to trees from localized point sources of emissions (Skelly 1989).

Mueller-Dombois (1987) has suggested that eastern North American oak decline may be a type of "natural" stand-level dieback known as cohort senescence.

OAK TYPES AND SPECIES IN THE CENTRAL FOREST REGION

Oaks in the region grow primarily in the three areas of lowlands, prairie, and uplands. Principal species of economic importance in the lowlands are swamp white oak (*Quercus bicolor*) cherrybark oak (*Q. falcata* var. *pagodaefolia*) and pin oak (*Q. palustris*). Pin oak is sometimes affected by the horned oak and gouty oak gall wasps in such numbers that entire stands decline and many trees die.

Prairie groves of oak are unique to the region. They occur in the transition zone between the western prairie and the eastern hardwood forest. At the time of settlement by European immigrants, these prairie groves consisted primarily of large fire-resistant bur oaks (*Q. macrocarpa*) growing in oak savannas created by repeated fires used by the Indians for vegetation and wildlife management. After settlement, prairie fires were largely controlled. Fire prevention

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allowed the increase of the more fire susceptible oaks—white oak (*Q. alba*) and black oak (*Q. velutina*)—and many prairie areas of oak openings quickly changed to forest (Curtis 1959). Of the prairie oaks, black oak has been most susceptible to stress, particularly drought, as might be suspected from the location in the forest-prairie transition zone.

Most reports of oak decline in the central forest region have involved upland oaks and in particular black oak. Black oak grows over a range of sites from droughty to mesic. Although fairly intolerant to shading, it is a relatively long-lived oak, particularly on good sites. The other upland oak often reported as declining is scarlet oak (*Q. coccinea*). Characteristics of scarlet oak include fast growth, shade intolerance, excellent sprouting ability, and adaptability to dry sites. Other common upland oaks in the central forest region and some of their characteristics are:

- northern pin oak (*Q. ellipsoidalis*)—the most xeric and the most shade intolerant, very fire susceptible but sprouts well;
- red oak (*Q. rubra*)—most shade tolerant and most nearly mesic of all the oaks, very susceptible to fire, sprouts poorly;
- white oak (*Q. alba*)—most tolerant of the white oaks, intermediate in fire resistance, and is a poor sprouter;
- chinquapin oak (*Q. muhlenbergii*)—very intolerant and the most xeric of the white oaks.

OAK CHARACTERISTICS FOR DECLINE SUSCEPTIBILITY

Oaks are colonizers. Unless disturbed, the same oak species does not generally succeed itself. Two oak successional patterns are relatively common: bur oak to black oak in the prairie groves, and black oak to white oak in the uplands. Although red oak is more shade tolerant than white oak, very few instances of white oak to red oak succession have been found.

Many oak species such as black, scarlet, and chestnut oak are found on inherently poor soils that are shallow or where nutrients could become limiting during stand life cycles. Other oaks such as pin, cherrybark, and swamp white grow in poorly drained areas, while oaks such as

northern pin and scarlet grow on excessively droughty ones.

RECENT STAND HISTORY AND OAK DECLINE

Many of the central forest oak stands now approaching maturity began when oaks colonized impoverished abandoned farmlands and burned-over areas. Land colonization by settlers in successive major waves led to cycles of forest clearing, exploitation of marginal land for farming, and subsequent abandonment of this land. As a result, stand ages tend to be similar in subregions of the central forest. This tendency is most evident in the forests of the Ozark Plateau in Arkansas and Missouri. These forests remained relatively undisturbed until railroads opened up the region in the 1880's. A great lumber boom began, providing wood for constructing railroad lines and new settlements to the west. During the boom period, which lasted until about 1920, many large lumber companies were formed. A typical pattern in the region was for the lumber companies to sell their cutover land to development companies. Land speculation in such poor cutover lands peaked during the 1920's. Attempts to farm the cutover lands usually failed, and the lands were abandoned. The Great Depression of the 1930's accelerated this pattern of abandonment. The oak forest that now occupies the cutover and abandoned lands largely originated from sprouts. Quality of this oak is generally inferior to that arising from seed (Roth and Sleeth 1939). Oaks of sprout origin often become infected with butt rot and canker-rot fungi through wounds that develop because of the death of companion sprouts in sprout clumps. As a consequence, these oaks often are defective in the region of their root collars.

Synchronization of tree age in stands ultimately produces cohorts of mature trees that will simultaneously develop traits of senescence. So it is likely that these trees will be especially susceptible to stresses such as drought and insect defoliation that would cause stand-wide decline.

OAK MANAGEMENT AND OAK DECLINE

Forest managers in the central forest area, with large acreages of oak-hickory forests, are currently reassessing their heavy reliance on even-aged management because of interests in other

values. Uneven-aged management using group selection may prove to be an appropriate system allowing for regulated harvesting that provides for adequate regeneration of these low light-intolerant species. In this system, regeneration space is created by removing tree clusters within the stand. Openings of one-half to 2 acres created by tree removal are recommended to regenerate intolerant oak species (Carvell and Tryon 1961, Sander and Clark 1971, Schlesinger 1976, Smith 1980).

Group selection has drawbacks when disease aspects are considered, however. On the Mark Twain National Forest, salvage logging operations of stands affected with oak decline often resemble group selection cuts. In many instances, such salvage cuts have intensified oak decline in the residual stands (personal communication with Jay Law and Leo Johnson, MTNF). In addition, border trees along clearcuts develop crown dieback and deterioration. These experiences suggest several pathological disturbances that could be in effect after stand opening. Among these are:

1. Intensified attack by root rot fungi from food bases provided by residual stumps and roots in the logged openings.
2. Higher soil temperatures injurious to fine roots and their mycorrhizal fungi.
3. Increased moisture stress from increased insolation of the ground in the openings.
4. Increased wood borer populations arising from colonization of stumps and logging debris.
5. Sunscalding of stems exposed after logging.
6. Logging wounds as infection courts for decay and canker fungi on residual trees from felling and skidding operations.
7. Increased susceptibility to radiation frosts for reproduction in the openings.

A slightly altered uneven-aged management system for oak stands could be used on public lands experiencing decline. In such a system, group selection would mean primarily the harvesting of dying and recently killed trees. This would require micro-management that would

include annual mortality inspections and timber harvests on short notice. On public lands a practical way to accomplish these goals would be to employ woodworkers to harvest trees and transport harvested logs to storage yards for later disposal through bidded sales.

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